

Preliminary Draft – Do Not Cite or Quote

**ATTACHMENT 4
ROG and NOx Emissions from Farm Equipment
San Joaquin Valley**

EMISSION INVENTORY SOURCE CATEGORY

Farm Equipment

EMISSION INVENTORY CODES (CES CODES) AND DESCRIPTION

870-xxx-xxxx-xxxx (xxxxx) Farm Equipment

In January, 2000, the Air Resources Board approved the emissions inventory for off-road compression-ignited (CI) engines. It included the emissions from thousands of pieces of equipment, which are used in off-road applications such as agriculture, construction, industrial, and commercial. This inventory utilized the latest data available at that time, which included information on industry trends provided through the public comment process. The revisions to the emissions inventory were developed with input solicited from various sources, such as air quality management districts, engine manufacturers, technical consultants, the Nisei Farmers League, California Cotton Ginners & Growers Associations, Equipment Manufacturers Institute (EMI), and San Joaquin Valley APCD.

Background

The emissions in tons per day for TOG, CO, NOx and PM were calculated using the following equation:

$$\text{Emissions in tpd} = \text{EF(g/hp-hr)} * \text{avg HP (hp)} * \text{Load Factor} * \text{Population} * \text{Activity (hr/day)}$$

Where:

tpd = tons per day

EF = emission factor for TOG or CO or NOx or PM

HP = horsepower

Activity = usage

The population for the agricultural equipment was obtained from several different sources, as shown in Table I. The statewide population was allocated to each county based on cultivated land acreage, and then grouped to form air basins within California. As a result, 45% of the total statewide agricultural equipment population is found within the San Joaquin Valley air basin.

Preliminary Draft – Do Not Cite or Quote

Table I: Input Factors for the Agricultural Category

Equipment	Population Source
Ag Mowers	Power Systems Research (PSR)
Ag Tractors	USDA 1997 Census of Agriculture
Balers	USDA 1997 Census of Agriculture
Combines	USDA 1997 Census of Agriculture
Hydro Power Units	Power Systems Research (PSR)
Irrigation Pumps	USDA 1994 Farm & Ranch Irrig. Survey
Other Ag Equipment	Power Systems Research (PSR)
Sprayers	Power Systems Research (PSR)
Swathers	Power Systems Research (PSR)
Tillers	Power Systems Research (PSR)

Activity is the equipment usage estimate, expressed as hours per year, and was obtained from the Power Systems Research 1996 Database (PSR). PSR is an independent research firm involved in research and development related to engine product life cycles. Their database contains engine data compiled over the past 7 years, including engine sales records for all engines sold in North America. Table II contains the input factors for the agricultural category.

The load factor is the average operation level in a given application as a percent of the engine manufacturer's maximum horsepower rating. Each engine in a specific application is assumed to operate for the average annual number of hours at the average load factor. The load factor is used to adjust the maximum rated horsepower to normal operative horsepower levels. The load factors for the agricultural category were obtained from the PSR database.

The average horsepower is the fleet-average rated horsepower assumed to be constant by calendar year based on the assumption that the power demand for this equipment has not changed over time. These values were obtained from the PSR database for the agricultural category.

A growth factor is applied in order to backcast and forecast. After correcting for inflation, the diesel fuel sales for agricultural applications data for 1977-1997 was used to determine the growth trend before 1997. During the finalization of the large CI inventory, the farm industry provided data that supported a decline in farmland acreage over the past several years. As a result, a 0.5% per year decrease in the growth was assumed after 1997.

Appendix A contains the emissions inventory for all agricultural equipment for 2000 and 2010 for San Joaquin Valley Air Basin.

Preliminary Draft – Do Not Cite or Quote

The emission factors are expressed in grams per horsepower-hour units and reflect USEPA's/California's adopted regulations. Appendix B of this document contains a table that lists the emission factors.

Table II: Input Factors for the Agricultural Category

Equipment	hp	1990 pop	2010 pop	Use Life	Avg Hp	BSFC	Activity	Load
Agricultural Mowers	120	65	67	16	65	0.49	363	0.43
Agricultural Tractors	50	42447	43932	16	39	0.54	475	0.70
	120	49091	50809	16	83	0.49	475	0.70
	175	27647	28614	16	142	0.47	475	0.70
	250	17858	18483	16	203	0.47	475	0.70
	500	3547	3671	16	332	0.41	475	0.70
Balers	50	2	2	16	50	0.54	95	0.58
	120	1380	1428	16	75	0.49	95	0.58
Combines	120	1036	1072	16	108	0.49	150	0.70
	175	1538	1591	16	142	0.47	150	0.70
	250	1644	1701	16	200	0.47	150	0.70
	500	66	68	16	275	0.41	150	0.70
Hydro Power Units	50	192	198	16	35	0.54	790	0.48
	120	18	18	16	70	0.49	790	0.48
Irrigation Pumps (Mobile only, most pumps are stationary)	50	556	575	16	37	0.54	749	0.65
	120	2805	2903	16	93	0.54	749	0.65
	175	392	405	16	151	0.54	749	0.65
	250	90	93	16	198	0.54	749	0.65
	500	7	7	16	333	0.54	749	0.65
Other Agricultural Equipment	50	506	523	16	40	0.54	381	0.51
	120	1708	1767	16	80	0.49	381	0.51
	175	142	146	16	145	0.47	381	0.51
	250	142	146	16	210	0.47	381	0.51
	500	34	35	16	302	0.41	381	0.51
Sprayers	50	69	71	16	36	0.54	90	0.50
	120	657	679	16	91	0.49	90	0.50
	175	276	285	16	151	0.47	90	0.50
	250	173	179	16	248	0.47	90	0.50
	500	29	30	16	271	0.41	90	0.50
Swathers	120	7464	7725	16	78	0.49	110	0.55
	175	67	69	16	150	0.47	110	0.55
Tillers >5 HP	250	1	1	16	245	0.47	172	0.78
	500	3	3	16	437	0.41	172	0.78

Activity is in hours per year